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telephony

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JOINT VENTURES
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$
MAND?
Operating costs
Why this zeal to enlighten others? First, to keep small companies strong since the new technology could replace fixed cable plant service. Second, unless small companies become involved, cellular will be dominated even more than wireline service is today by the large communications groups.
OPPORTUNITY, THREAT
Positive net income

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There are many different factors to consider when planning a cellular mobile system—particularly in a rural setting. And, economics is the bottom line.

Cover design by Leon Dankovics

Chasing a rural cellular rainbow

LeROY T. CARLSON JR.,
H. DONALD NELSON
and GARY L. HENSHUE

This article on the cellular opportunities for telcos in rural areas is based on a comprehensive study prepared by Telephone & Data Systems, Inc., Chicago. The TDS cellular financial program is available to telephone industry personnel under conditions noted in the article. Also, authors Nelson and Henshue will be happy to answer questions. For more information, call U.S. Cellular Corp. at (312) 696-3500.

IS CELLULAR radio telephone feasible for rural areas?

Telephone and Data Systems (TDS) is comprised of 57 small rural telephone companies, all of which are financed by the Rural Electrification Administration (REA) or are applicants for REA financing. In 1981 TDS, with its small town and rural outlook, saw cellular radio telephone as an opportunity for and a threat to its present and future telephone business. TDS saw it as a way to bring a whole new dimension of personal freedom in communications to its subscribers.

The company took aggressive action to file for cellular licenses wherever the Federal Communications Commission (FCC) Rules requiring telephone wireline presence would allow TDS to do so. Thus far, this has involved filing for 13 markets. TDS will be the operating partner in two of these markets: the standard metropolitan statistical area (SMSA) surrounding Tulsa, Okla., and the SMSA surrounding Knoxville, Tenn. TDS also has a minority position in 11 other markets, from a high of 49% in Nashville, Tenn., to 1.9% in Fresno, Calif.

Five applications were filed on July 16, 1984, in markets 91-120.

The corporate management team made an early decision to keep other small telephone companies fully informed on the great potential of cellular. TDS executives have made numerous presentations to the United States Telephone Assn. (USTA) and state association con-

LeRoy T. Carlson Jr. is President of Telephone and Data Systems, Inc. (TDS), Chicago. *H. Donald Nelson* is Executive Vice President and *Gary L. Henshue* is Manager of Finance of U.S. Cellular Corp., a subsidiary of TDS based in Park Ridge, Ill., a suburb of Chicago.

	A Northeastern State		A Southern State	
Prominent Industries w/ Greatest Interest	-Construction -Agriculture -Manufacturing	-Extraction -Retail -Wholesale	-Construction -Manufacturing -Transport	-Wholesale -Retail
Job Title	President - Owner - Manager		President - Owner - Manager	
Business Size	76% Less than 10 Employees		69% Less than 10 employees	
Travel Away From Office	78% More than 3 hours per day 75% More than 30 miles per day		68% More than 3 hours per day 68% More than 25 miles per day	
Distance Called	Local Local - Toll Intrastate Local Interstate L.D. International	40.3% 13.8 23.7 13.4 -0-	79.9% 0.4 10.4 9.1 0.3	
Roaming	58% travel more than 9 times per month to other major cities 33% would subscribe to roaming 3.5 calls per day		37% travel more than 9 times per month 37% would subscribe to roaming 6.8 calls per day	
Product	67% prefer mobile/portable unit		63% prefer mobile/portable unit	

FIG. 1 *Cellular rural user profile.*

ventions about cellular radio's future and how a small company can become a part of it.

Why this zeal to enlighten others? First, the small companies in the industry must stay strong because the new technology could replace today's fixed cable plant service. Second, unless small companies become involved, cellular will be dominated even more than wireline service is today by the large communications groups. Third, TDS wants to offer its services to small companies which are interested in cellular, but which prefer to pursue it with a knowledgeable joint venture partner, a partner from their own industry.

It is, of course, more important to emphasize the opportunities presented by cellular, rather than the threats.

The opportunities include:

- There is substantial new radio spectrum availability. Never before has the FCC given one company even close to 333 frequencies to use to provide customer services.
- There is far better service to new and existing customers, with quality equal to or better than landline, plus mobility and privacy.
- There is a competitive environment to build for the future. The cost of service is expected to decline substantially through the use of microelectronics in customer units.

TDS has a broad, positive view of the future of telecommunications, a view which foresees a major role for cellular.

Believing in both the opportunity of cellular and in its potential threat to current landline technology, TDS has aggressively planned to file for more than 70 additional metropolitan statistical area (MSA) and non-MSA areas.

Many small telephone companies are unwilling to file for the cellular market in their geographic area unless they have a knowledgeable, resourceful partner that is truly concerned with the small company's needs and which can assist the small company in market research, financial analysis, system design, negotiation with other filers, system construction, system marketing and system operation.

TDS realizes that a small company will be better off controlling its own cellular system than being consigned a very small minority investor interest in a system dominated by one of the industry giants. Almost 30 TDS filings will involve this type of joint venture; some are with telephone cooperatives and others are with family owned telephone companies. In each case, the small telephone company is the 51% or greater majority partner; and TDS is the minority partner providing substantial assistance. The right to file under FCC rules for the cellular radio telephone license is the small telephone company's birthright; once it's gone, it's gone forever. It's only a valuable birthright if the telephone company with the presence files for the market on the appropriate date. TDS believes that SMSAs (or, as they are now called, MSAs) and many non-MSAs which are properly equipped and tightly managed will be profitable. Which non-MSAs will be profitable or feasible?

While there are 175 more MSAs still to be filed after July 16, 1984, which telcos should examine carefully, there is a much greater number of non-MSA areas. The discussion now will focus on the non-MSAs, although everything in the financial model can be used for MSA markets as well.

Rules

The FCC non-MSA rules adopted May 17, 1984, state simply:

- wireline set aside remains for filing;
- a maximum of 2000 square miles can be filed for per filing;
- one-day filing (probably in 1986);
- major towns to be listed;
- lottery will be used; and
- uncontested wireline geography will be thereafter opened to non-wireline companies at later date.

It is quite possible that the FCC will change or revise the rules, but for now everyone must plan on using these assumptions.

Telcos should have some idea as to general cellular costs in order to choose initial service areas wisely. The costs of the cellular switch, cell site controllers and radio equipment all must be considered. Small market switches and cell site equipment on a turnkey basis sized for 300 cellular phones will be available for less than $450,000, or $1500 per phone. Both technology and costs are within this range today and improvements can be anticipated. However, there are more than system equipment costs that need to be considered. For example, there is now sufficient information on subscriber equipment to foresee the strong possibility of a $1000 mobile equipment retail price by the time the non-MSAs are on the air. Subscriber equipment prices are falling rapidly.

Analysis and planning are the keys

to a successful cellular radio telephone business. To achieve a high level of understanding and reasonable accuracy for a profitable decision, TDS' cellular market analysis follows these five basic steps:

- determine the demand for cellular service in the proposed service area;
- develop an engineering plan;
- integrate the demand study with the engineering plan;
- obtain equipment cost quotations from vendors; and
- analyze the financial consequences of all of the previous four steps.

With the IBM personal computer model TDS has put together, the company can illustrate how to work with proposed service areas and figure the financial feasibility of a cellular radio telephone system. This model and a descriptive user booklet will be made available to small telephone companies and cooperatives at the nominal price of $300, which is less than cost, in the interest of ensuring the future of the companies. The model also will be available without charge to the REA and to those companies which elect to have TDS as a joint venture partner. Users will also need access to Lotus 1-2-3 software to run the model.

Demand study

Using its general cellular expertise, TDS makes a preliminary definition of a potential cellular service area and a rough outline of the several cells comprising it. Then a demand study is made.

A great deal of data exists that can aid in determining demand. TDS does not have all of the data resources within the company necessary to compile an accurate marketing study, so Arthur D. Little, a consulting firm, has been chosen to help in determining the demand for cellular radio telephone service in each geographic area. With more than 70 individual demand studies completed, TDS has learned what is available, what is useful and how to establish a reasonable, cost effective method of determining the number of cellular radio telephone subscribers in year 1 through year 10.

Two information sources which are available do not require an outside consultant. They are state maps and U.S. government census tract data. Both are useful when non-MSAs are considered because the data is available on a county-wide basis.

The 1980 census data by census tract has proven to be very useful and is available from government sources on a statistical basis and from several sources on a map overlay basis. Combining the 1980 census with earlier data helps to project growth through 1984 and also for the next 5 to 10 years, the period of the cellular feasi-

Continued on page 36

FIG. 2 *Request for equipment quotation.*

MARKET NUMBER

	SWITCH	CELL 1	CELL 2	CELL 3	CELL 4	CELL 5	CELL 6	CELL 7	TOTAL
Year 3 Subscribers		---	---	---	--	---	---	---	----
Year 3 Channels									
Year 5 Subscribers		---	---	---	---	---	---	---	----
Year 5 Channels									
Height									
Control Switching Equipment									
Cell Site Equipment									
Cell Site Buildings									
Antennas & Cables									
Engineering &Installation									
Spares & Maintenance Tools									
Test Equipment									
Documentation									
Training									
Power & Battery									
Other									
TOTAL									
GRAND TOTAL									

* Includes 1 control channel per site

STUDY SUBJECT..... LOW COST NON-MSA
STUDY DATE..... 08/29/84
PREPARED BY..... BLH
EQUIPMENT SUPPLIER.. LOW COST DOMESTIC SUPPLIER
REV 08/84

LINE NO.	NON-MSA DESCRIPTION	TOTAL CELLULAR DEMAND (1) 1985	1986	1987	1988	1989	ESTIMATED 1989 POPULATION	ESTIMATED 1989 EMPLOYMENT	1989 DEMAND/ POPULATION	1989 DEMAND/ EMPLOYMENT	NUMBER OF PROPOSED CELLS	NUMBER OF SQ. MILES	1989 POP. DENSITY PER CELL	1989 POP. DENSITY PER SQ. MILE	LINE NO.
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
1.	MARKET A	237	313	474	710	947	120,755	46,953	0.8%	2.0%	2	930	60,378	130	1.
2.	MARKET B	702	926	1,404	2,105	2,807	223,102	107,133	1.3%	2.6%	4	2,000	55,776	112	2.
3.	MARKET C	187	247	374	560	747	86,213	32,694	0.9%	2.3%	3	1,331	28,738	65	3.
4.	MARKET D	120	158	240	359	479	47,895	21,712	1.0%	2.2%	2	1,104	23,598	43	4.
5.	MARKET E	292	386	585	877	1,169	85,291	42,110	1.4%	2.8%	2	599	41,646	140	5.
6.	MARKET F	563	743	1,125	1,688	2,250	173,748	82,938	1.3%	2.7%	4	1,612	43,042	108	6.
7.	MARKET G	457	603	914	1,371	1,828	148,475	75,104	1.2%	2.4%	3	1,110	49,492	133	7.
8.	TOTAL	2,557	3,375	5,116	7,670	10,227	882,799	408,644			20	8,691	303,067	730	8.
9.	AVERAGE CELLULAR DEMAND	365	482	731	1,096	1,461	126,114	58,378	1.2%	2.5%	2.9	1,242	44,140	101.6	9.
10.	AVERAGE WIRELINE CELLULAR DEMAND	183	241	365	548	731			0.6%	1.3%					
11.	AVERAGE INVESTMENT PER WIRELINE CUSTOMER	$5,302	$4,016	$2,651	$1,767	$1,325									

(1) BASED ON A.D. LITTLE MARKET STUDIES.

FIG. 3 *The results of cellular market demand studies for seven non-MSA markets.*

bility study. Much more could be said about this area, but telcos should consult specialists; they will save time and money.

TDS has chartered A. D. Little to make a telephone survey of potential users for every market filing it has done. This is at an additional cost but is well worth the expense since it is an important key to understanding the feasibility and demand differences by market. Studies show that initial cellular demand can vary from as low as 1.5% to as high as 3.5% of employment, which are vast differences. In planning a system, TDS prefers to know as much as possible because new market development uncertainties and substantial dollar commitments are involved.

A brief outline of the telephone interview procedure and the elements that appear most useful will be interesting. Through its opinion research subsidiary in Princeton, N.J., A. D. Little calls businesses from a sample drawn using SICs, or standard industrial codes. More than 200 codes and sub-codes have proven to be potential cellular radio telephone users.

Is there a difference from urban to rural? Yes. Is there a regional difference from Northeast to Midwest to Southwest? Again, the answer is yes.

The 10 to 15 minute telephone interview is aimed at persons who are away from a phone 2 hours or more per day and seeks to determine three key things:

- what telephone usage would be if a cellular phone were available;
- price levels people are willing to pay; and
- travel patterns.

Many more facets are learned through this study. Respondents want to discuss their telecommunications needs and wants, to understand the concept of cellular and to express their price/usage trade-off relationships. Interviewees consistently demonstrate a strong desire for cellular as a tool to improve their productivity.

The data obtained in the interview, the map studies and the census tract data is reduced to potential subscribers per cell. One caution which must be considered is that the subscriber has a home and, for consistency, that is where TDS locates him or her. The problem, of course, is that the driveway is not the principle place of use for a cellular telephone. Thus, A. D. Little has developed a model based upon all the related elements to adjust for actual location usage.

A user profile using data from A. D. Little studies of two different geographic areas, one in the Northeast and the other in the Southeast, is shown in Figure 1.

The engineering plan is familiar to all telcos. Included is the radio transmission and propagation plan for the geographic area, which is most often represented by the Carey curve circles on the 250 mile map of the area. Radio transmission is different and less predictable than landline transmission. Having the best possible knowledge of the actual radio radiation pattern is paramount to designing a good system. Based on the demand study, the initial service area and cell locations are reviewed and, if need be, revised, sometimes substantially, to provide optimal coverage in the highest traffic areas and continuous coverage within the overall service area while still observing such

Continued on page 41

engineering design concepts as grid patterning to ensure future efficiency as the system demand grows and cell splitting occurs.

This integration of the market demand study with the engineering plan requires considerable talent and skill. The number of subscribers per cell leads to the number of channels per cell, which leads to the cell size and sites, and then to central switch and system capacity. While a first year plan by cell site and for the system is necessary so is a model that takes population, technology and service into consideration over a longer period; thus, demand forecasts and engineering plans are integrated year by year into a 10-year plan with subscribers per cell. With the detail now completed as to number of cells, number of subscribers by cell, tower heights, terrain considerations and levels of service, initial equipment quotations can be obtained. Final equipment prices will be subject to much hard bargaining after a license has been granted.

Telcos will only get what they ask for from some manufacturers when they ask for equipment quotations, so it is important to be very specific. TDS has a team that is primarily focused on marketing and operating cellular systems. Thus, the company depends heavily on vendors for constructing the systems. Manufacturers therefore, are expected to provide turnkey cellular telephone systems. The format TDS uses to request budgetary equipment costs for MSA and non-MSA markets is shown in Figure 2. It was developed to avoid an excessive variety of interpretations. It's simple and encompassing, and it makes two or more equipment quotations comparable.

TDS requests equipment costs through year 3 and year 5. Trends toward lower costs of switching and cell site equipment, and substantially lower prices for subscriber units, may cause subscriber demand to quickly grow higher than the forecasted year 1 level. The service provider must have sufficient system capacity to maintain top quality service levels if this occurs.

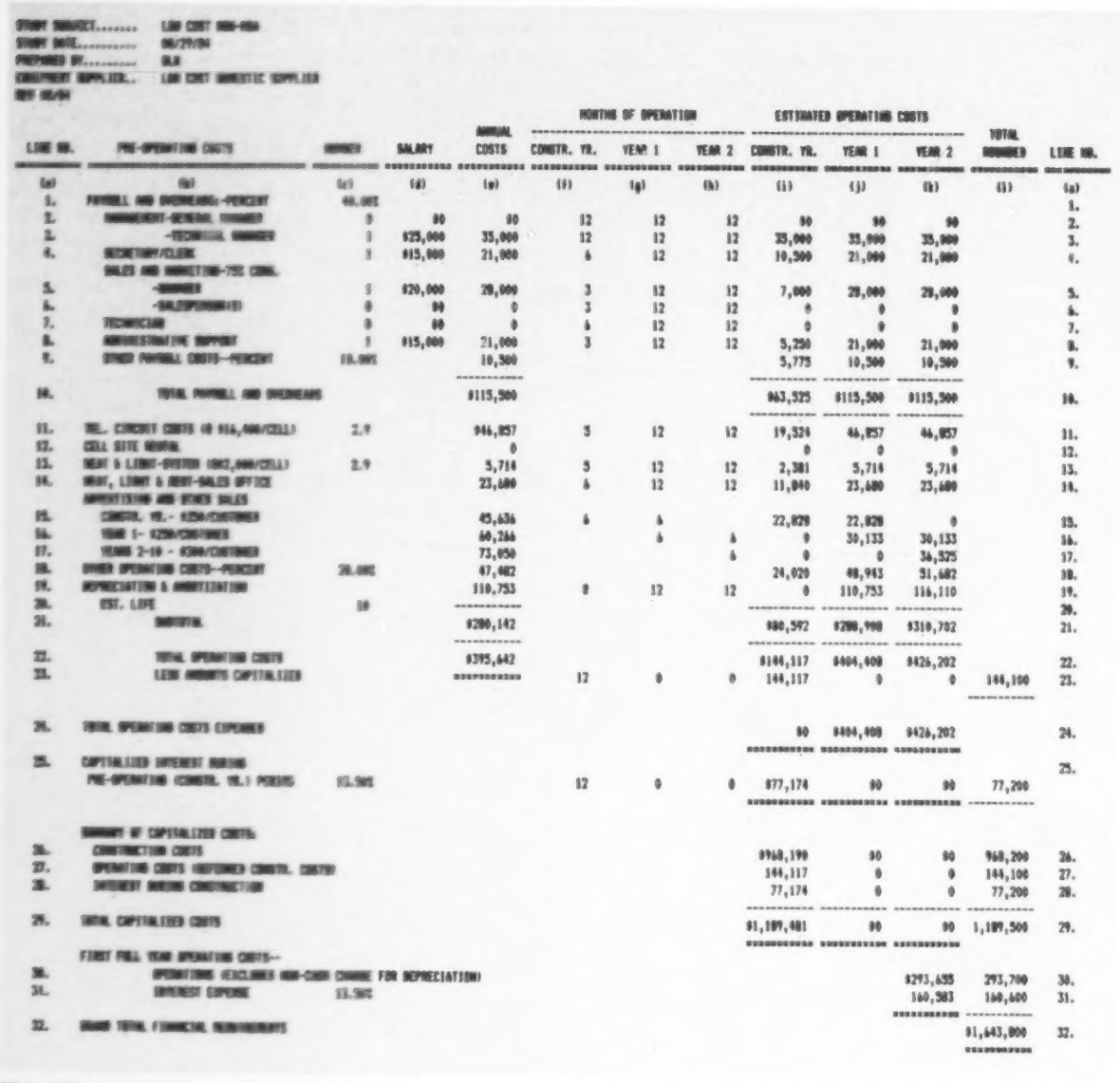
TDS also requests these two points in time for equipment costs because some manufacturers have system designs where the cost of equipment and memory are primarily in the orig-

FIG. 4 *The cellular plant construction costs for 17 different plant categories.*

STUDY SUBJECT..... LOW COST NON-MSA
STUDY DATE..... 08/29/84
PREPARED BY..... GLH
EQUIPMENT SUPPLIER.. LOW COST DOMESTIC SUPPLIER
REV 08/84

LINE NO.	PLANT CATEGORY	NON-MSA DESCRIPTION: MARKET A	MARKET B	MARKET C	MARKET D	MARKET E	MARKET F	MARKET G	TOTAL	AVERAGE COST	LINE NO.
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	LAND										
1.	-EASEMENTS (1)	$13,072	$26,144	$19,608	$13,072	$13,072	$26,144	$19,608	$130,720	$18,674	1.
	BUILDINGS										
2.	-CELL SITE	$0,860	$21,720	$20,000	$0,000	$0,000	$40,000	$20,000	$42,580	$6,083	2.
3.	-OFFICE	0	0	0	0	0	0	0	0	0	3.
4.	CONTROL SWITCHING EQUIPMENT (MTSO) (2)	$66,000	$99,000	$91,000	$48,000	$84,000	$05,000	$41,000	$,534,000	$19,143	4.
5.	CELL SITE EQUIPMENT	$42,300	$65,100	$37,950	$29,800	$10,800	$94,600	$89,200	$,739,750	$48,536	5.
6.	-ANTENNAS & CABLES	$0,500	$1,000	$5,750	$0,500	$0,500	$1,000	$5,750	$05,000	$5,000	6.
7.	TEST EQUIPMENT	$4,000	$6,000	$5,000	$4,000	$4,000	$6,000	$5,000	$74,000	$4,057	7.
8.	TRANSMISSION-DIGITAL CARRIER (3)	$5,466	$0,932	$8,199	$5,466	$5,466	$0,932	$8,199	$54,660	$6,380	8.
9.	VEHICLES (@15,000 PER UNIT)	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$10,000	$0,000	9.
10.	SPARES,MAINTENANCE,TOOLS	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$40,000	$0,000	10.
11.	OFFICE FURNITURE & EQUIPMENT	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$80,000	$0,000	11.
	OTHER										
12.	-GENERAL	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$0,000	$40,000	$0,000	12.
13.	-DOCUMENTS	0	0	0	0	0	0	0	0	0	13.
14.	-TRAINING	$,000	$,000	$,000	$,000	$,000	$,000	$,000	$8,000	$,857	14.
15.	-ENGINEERING & INSTALLATION	$1,000	$4,500	$6,000	$1,500	$0,500	$05,500	$0,000	$71,000	$7,286	15.
16.	-POWER & BATTERY (4)	$8,900	$9,700	$1,500	$6,500	$3,700	$0,100	$1,100	$91,500	$7,357	16.
17.	MISCELLANEOUS & CONTINGENCIES 10.00%	$4,010	$15,210	$9,201	$0,404	$4,804	$20,720	$7,686	$66,121	$8,017	17.
18.	TOTAL CONSTRUCTION COSTS (5)	$704,108	$1,267,306	$871,208	$665,322	$822,842	$1,372,004	$1,074,543	$6,777,331	$968,190	18.
19.	NUMBER OF PROPOSED CELLS	2	4	3	2	2	4	3	20	2.9	19.
20.	INVESTMENT PER CELL WITH MTSO	$352,054	$316,826	$290,403	$332,661	$411,421	$343,001	$358,181		$338,867	20.
21.	INVESTMENT PER CELL WITHOUT MTSO	$267,054	$202,076	$226,736	$250,661	$319,421	$266,751	$277,848		$262,167	21.

(1) BASED ON AVERAGE OF $6,536 PER CELL.
(2) INCLUDES ONE CONTROL CHANNEL PER SITE.
(3) BASED ON AVERAGE OF $12,733 PER CELL.
(4) FOUR HOURS AT CELL SITE AND SWITCH.
(5) BASED ON PRICE QUOTES FROM LOW COST DOMESTIC SUPPLIER, EXCEPT FOR EASEMENTS, BUILDINGS, DIGITAL CAR., VEHICLES, OFFICE EQUIP., AND CONTINGENCIES.



LINE NO.	PRE-OPERATING COSTS	NUMBER	SALARY	ANNUAL COSTS	MONTHS OF OPERATION CONSTR. YR.	YEAR 1	YEAR 2	ESTIMATED OPERATING COSTS CONSTR. YR.	YEAR 1	YEAR 2	TOTAL NUMBER	LINE NO.
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(a)
1.	PAYROLL AND OVERHEADS: -PERCENT	40.00%										1.
2.	MANAGEMENT-GENERAL MANAGER	0	$0	$0	12	12	12	$0	$0	$0		2.
3.	-TECHNICAL MANAGER	1	$25,000	35,000	12	12	12	35,000	35,000	35,000		3.
4.	SECRETARY/CLERK	1	$15,000	21,000	6	12	12	10,500	21,000	21,000		4.
	SALES AND MARKETING-TSI CORP.											
5.	-MANAGER	1	$20,000	28,000	3	12	12	7,000	28,000	28,000		5.
6.	-SALESPERSON(S)	0	$0	0	3	12	12	0	0	0		6.
7.	TECHNICIAN	0	$0	0	6	12	12	0	0	0		7.
8.	ADMINISTRATIVE SUPPORT	1	$15,000	21,000	3	12	12	5,250	21,000	21,000		8.
9.	OTHER PAYROLL COSTS--PERCENT	10.00%		10,500				5,775	10,500	10,500		9.
10.	TOTAL PAYROLL AND OVERHEADS			$115,500				$63,525	$115,500	$115,500		10.
11.	TEL. CIRCUIT COSTS ($ 16,000/CELL)	2.9		$46,057	3	12	12	19,324	46,057	46,057		11.
12.	CELL SITE REPAIR			0				0	0	0		12.
13.	HEAT & LIGHT-SYSTEM ($2,000/CELL)	2.9		5,714	3	12	12	2,381	5,714	5,714		13.
14.	HEAT, LIGHT & REP-SALES OFFICE			23,600	6	12	12	11,040	23,600	23,600		14.
	ADVERTISING AND OTHER SALES											
15.	CONSTR. YR.- $250/CUSTOMER			45,636	6	6		22,820	22,820	0		15.
16.	YEAR 1- $250/CUSTOMER			60,266		6	6	0	30,133	30,133		16.
17.	YEARS 2-10 - $200/CUSTOMER			73,050			6	0	0	36,525		17.
18.	OTHER OPERATING COSTS--PERCENT	20.00%		67,402				24,920	48,943	51,682		18.
19.	DEPRECIATION & AMORTIZATION			110,753	0	12	12	0	110,753	116,110		19.
20.	EST. LIFE	10										20.
21.	SUBTOTAL			$280,142				$80,592	$280,990	$310,702		21.
22.	TOTAL OPERATING COSTS			$395,642				$144,117	$404,490	$426,202		22.
23.	LESS AMOUNTS CAPITALIZED				12	0	0	144,117	0	0	144,100	23.
24.	TOTAL OPERATING COSTS EXPENSED							$0	$404,490	$426,202		24.
25.	CAPITALIZED INTEREST DURING PRE-OPERATING (CONSTR. YR.) PERIOD	13.50%			12	0	0	$77,174	$0	$0	77,200	25.
	SUMMARY OF CAPITALIZED COSTS:											
26.	CONSTRUCTION COSTS							$960,190	$0	$0	960,200	26.
27.	OPERATING COSTS (EXPENSED CONSTR. COSTS)							144,117	0	0	144,100	27.
28.	INTEREST DURING CONSTRUCTION							77,174	0	0	77,200	28.
29.	TOTAL CAPITALIZED COSTS							$1,189,481	$0	$0	1,189,500	29.
	FIRST FULL YEAR OPERATING COSTS--											
30.	OPERATIONS (EXCLUDES NON-CASH CHARGE FOR DEPRECIATION)									$293,635	293,700	30.
31.	INTEREST EXPENSE	13.50%								160,583	160,600	31.
32.	GRAND TOTAL FINANCIAL REQUIREMENTS										$1,643,800	32.

FIG. 5 *The operating costs for non-MSA cellular system for the first 2 years of operation.*

inal installation; while others have distributed systems where the memory and some equipment is decentralized and, thus, have lower first costs with higher expansion costs.

Questions that are very important to ask are: what are the channel costs and how long will delivery of channel banks be from date of order? Quarterly prices for channel cards are available, so it also is important to ask about these prices.

How are all of these factors tied together in a cellular model using best estimates of demand, costs and the competitive environment?

The rest of this article will guide the reader through the cellular system financial planning model that will provide the quantitative data a telco needs to estimate the feasibility of cellular for a given rural area. 1-2-3 program and TDS cellular model diskette will be the basic tools. [This discussion is based on an original document prepared by TDS which included 22 pages of supplementary material, most of which are referred to as "exhibits." This article uses seven of the exhibits and designates them "figures." Among the most important exhibits which are not used in this article are exhibits with information on construction payment schedules, cellular prices and usage, projected customers and revenue data, and projected investment and financing data.]

Figure 3 summarizes the results of cellular market demand studies prepared by A.D. Little for TDS for seven non-MSA markets. These markets are typical of the market areas the TDS companies and its joint ventures plan to file for in the non-MSA cellular round of filings. The total cellular demand (wireline and non-wireline) in units (mobile and portable) combined for years 1-5 (1985-1989) is shown by market in columns (C) through (G) on lines 1 through 7. There are wide variations from market to market in total demand. Columns (H) and (I) show the estimated 1989 population and employment for the seven non-MSA cellular markets. Again, there are wide variations and the relationship between population and employment varies from market to market. Columns (J) and (K) reflect calculations that take the year 5 (1989) estimated cellular demand and

Continued on page 46

divide this by the estimated population and employment. Column (L) shows the proposed number of cells for each market. Column (M) shows the total square miles for the portion of the counties included in each cell service area for the total of all cells. Column (N) calculates the density of the estimated 1989 population per cell. This calculation is column (H) divided by column (L). This density ranges from a high of 60,378 population per cell to a low of 23,598 population per cell. Column (O) calculates the density per square mile of the 1989 population. The calculation takes column (H) and divides it by column (M). As can be seen in column (O), the population density per square mile for the seven markets ranged from 43 per square mile to 140 per square mile.

Line 9 in Figure 3 calculates the averages for columns (C) through (O) for the seven non-MSA markets. Columns (C) through (G) show average total demand rising from 365 units in the first year to 1461 units in the fifth year. As calculated on line 9 of column (H) and (I), the average population and employment in the non-MSA's analyzed is 126,114 and 58,378, respectively. Of particular significance are columns (J) and (K) on this line. They show that in the year 1989, it is estimated that 1.2% of the total population and 2.5% of those employed in these seven markets will demand cellular radio service. The averages for these markets are in line with the results A.D. Little obtained in its studies of the top 90 markets. A word of caution: it is possible to be misled by averages and they should never be applied to any specific market. TDS has seen market research showing figures ranging from 0.7% to 1.7% for demand as a percentage of population and from 1.5% to 3.5% for demand as a percentage of employment. Market research specific to a particular market should always be obtained before designing a system. The last four columns on line 9 also are instructive. They show that the average system has 2.9 cells, covers 1242 square miles and has population densities of 44,140 per cell and 101.6 per square mile.

Line 10 of Figure 3 shows the estimated average wireline cellular demand for year 1-5. These demand numbers are calculated by taking 50% of the total cellular demand, as shown on line 9. This assumes that the total customer base is split 50% wireline and 50% non-wireline. Thus, in year 1 it is anticipated that the wireline company in an average market would provide service to 183 customers; year 2, to 241 customers; and in year 5, to 731 customers.

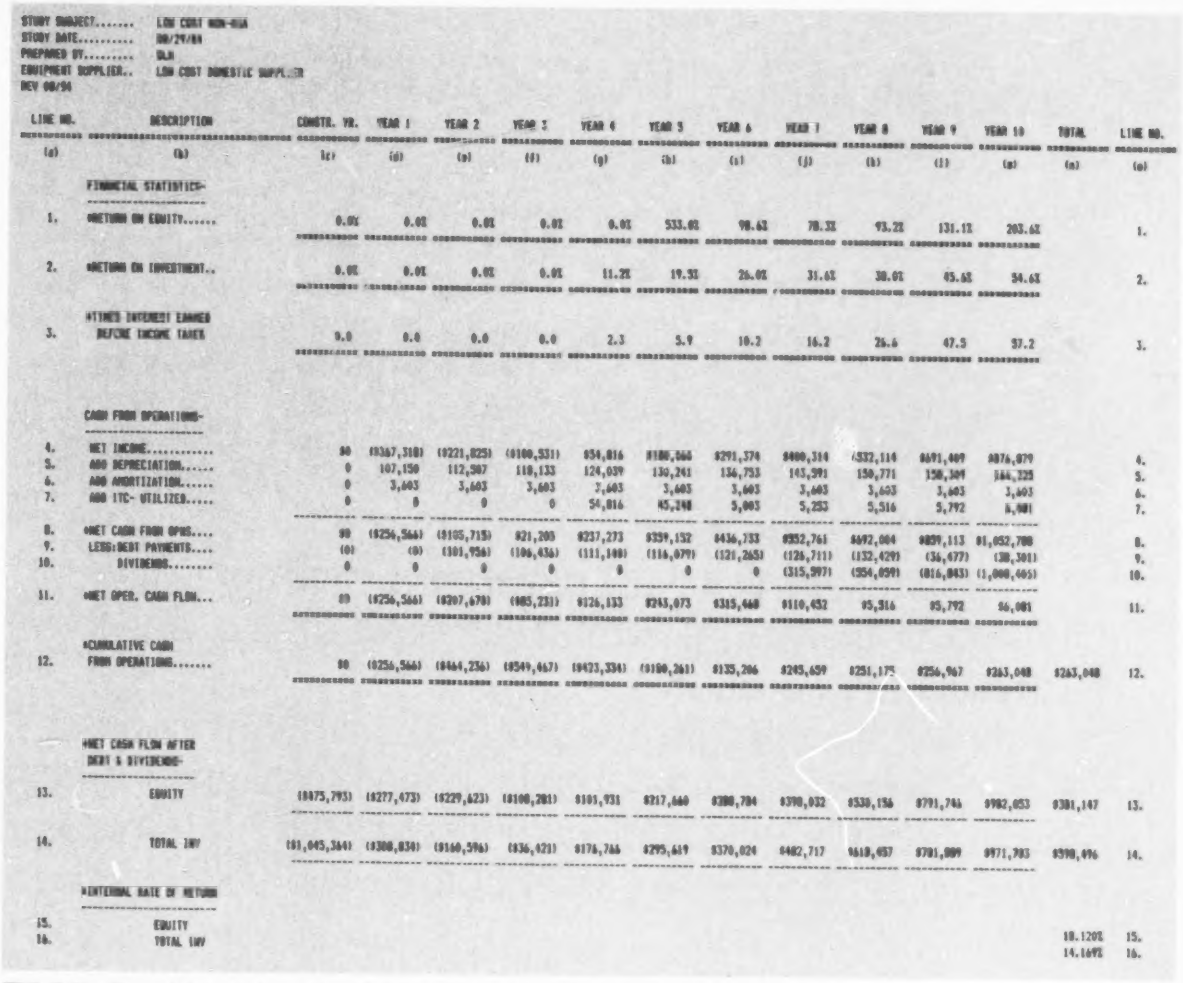
On line 11 of Figure 3, the average cellular plant investment per wireline customer has been calculated using data shown in Figure 4. This excludes customer equipment. The calculation takes the average construction costs from column (K), line 18 Figure 4 for the low cost domestic supplier and

Continued on page 50

FIG. 6 *A look at the financial feasibility of cellular radio in rural areas.*

STUDY SUBJECT..... LOW COST NON-MSA
STUDY DATE..... 08/29/84
PREPARED BY..... GLH
EQUIPMENT SUPPLIER.. LOW COST DOMESTIC SUPPLIER
REV 08/xx

LINE NO.	DESCRIPTION	CONSTR. YR.	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	TOTAL	LINE NO.
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
	OTHER ASSUMPTIONS-													
1.	INCOME TAX RATE.....	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%		1.
2.	INFLATION RATE.....	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%		2.
3.	CUSTOMER SERVICES COST PER UNIT....	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00		3.
	INCOME STATEMENT-													
4.	REVENUES.....	$0	$136,696	$309,829	$444,187	$460,869	$934,955	$1,173,702	$1,408,443	$1,690,131	$2,028,158	$2,433,789		4.
	OPERATING EXPENSES....													
5.	PAYROLL AND OVERHEADS	$0	$115,500	$115,500	$121,275	$127,339	$133,706	$140,391	$147,411	$154,781	$162,520	$170,646		5.
6.	CUSTOMER SERVICES	0	1,141	2,648	3,789	5,707	7,990	10,644	12,853	14,464	17,337	20,828		6.
7.	ADVERTISING	0	52,941	44,650	49,991	73,691	77,165	81,023	85,075	89,328	93,795	98,484		7.
8.	TEL. CIRCUIT COSTS	0	44,857	44,857	49,200	51,660	54,243	56,955	59,803	62,793	65,933	69,229		8.
9.	CELL SITE RENTAL	0	0	0	0	0	0	0	0	0	0	0		9.
10.	UTILITIES	0	29,394	29,394	30,864	32,407	34,028	35,729	37,515	39,391	41,361	43,429		10.
11.	OTHER OPERATING	0	48,943	51,682	54,266	56,979	59,828	62,820	65,961	69,259	72,722	76,358		11.
12.	TOTAL OPER. COSTS	$0	$294,797	$312,740	$329,386	$347,583	$366,959	$386,962	$408,617	$430,016	$453,687	$478,974		12.
13.	DEPRECIATION.....	$0	$107,150	$112,507	$118,133	$124,039	$130,241	$136,753	$143,591	$150,771	$158,309	$166,225		13.
14.	AMORTIZATION.....	0	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603		14.
15.	NET OPER. INCOME BEFORE INCOME TAXES..	$0	($268,854)	($119,021)	$46,934	$195,644	$434,151	$646,384	$853,632	$1,105,742	$1,412,299	$1,784,987		15.
16.	INTEREST COST.....	$0	$98,465	$102,004	$93,597	$84,013	$74,022	$63,636	$52,804	$41,515	$29,742	$31,229		16.
17.	=TAXABLE INCOME.....	$0	($367,318)	($221,025)	($100,531)	$109,631	$360,119	$582,747	$800,828	$1,064,228	$1,382,817	$1,753,758		17.
18.	INCOME TAXES	$0	$0	$0	$0	$54,816	$180,060	$291,374	$400,314	$532,114	$691,409	$876,879		18.
19.	INV. TAX CREDITS	28,802	3,920	4,116	4,322	4,538	4,765	5,003	5,253	5,516	5,792	6,081	$27,709	19.
20.	ITC- UTILIZED	0	0	0	0	54,816	45,240	5,003	5,253	5,516	5,792	6,081		20.
21.	=NET INCOME.....	$0	($367,318)	($221,025)	($100,531)	$54,816	$180,060	$291,374	$400,314	$532,114	$691,409	$876,879		21.



STUDY SUBJECT..... LOW COST NON-MSA
STUDY DATE..... 08/29/84
PREPARED BY..... DLH
EQUIPMENT SUPPLIER.. LOW COST DOMESTIC SUPPLIER
REV 08/84

LINE NO.	DESCRIPTION	CONSTR. YR.	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	TOTAL	LINE NO.
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
	FINANCIAL STATISTICS-													
1.	*RETURN ON EQUITY.....	0.0%	0.0%	0.0%	0.0%	0.0%	533.0%	98.6%	78.3%	93.2%	131.1%	203.6%		1.
2.	*RETURN ON INVESTMENT..	0.0%	0.0%	0.0%	0.0%	11.2%	19.3%	26.0%	31.6%	38.0%	45.6%	54.6%		2.
3.	*TIMES INTEREST EARNED BEFORE INCOME TAXES	0.0	0.0	0.0	0.0	2.3	5.9	10.2	16.2	26.6	47.5	97.2		3.
	CASH FROM OPERATIONS-													
4.	NET INCOME.....	$0	($367,310)	($221,825)	($100,531)	$54,816	$180,266	$291,374	$400,314	$532,114	$691,409	$876,079		4.
5.	ADD DEPRECIATION.....	0	107,150	112,507	118,133	124,039	130,241	136,753	143,591	150,771	158,309	166,225		5.
6.	ADD AMORTIZATION.....	0	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603		6.
7.	ADD ITC- UTILIZED.....	0	0	0	0	54,816	45,248	5,003	5,253	5,516	5,792	6,081		7.
8.	*NET CASH FROM OPNS....	$0	($256,566)	($105,715)	$21,205	$237,273	$359,152	$436,733	$552,761	$692,004	$859,113	$1,052,788		8.
9.	LESS:DEBT PAYMENTS....	($0)	($0)	($101,956)	($106,436)	($111,140)	($116,079)	($121,265)	($126,711)	($132,429)	($36,677)	($38,301)		9.
10.	DIVIDENDS.....	0	0	0	0	0	0	0	($315,997)	($554,890)	($816,843)	($1,008,465)		10.
11.	*NET OPER. CASH FLOW...	$0	($256,566)	($207,670)	($85,231)	$126,133	$243,073	$315,468	$110,052	$5,316	$5,792	$6,081		11.
12.	*CUMULATIVE CASH FROM OPERATIONS.....	$0	($256,566)	($464,236)	($549,467)	($423,334)	($180,261)	$135,206	$245,259	$251,575	$256,967	$263,048	$263,048	12.
	*NET CASH FLOW AFTER DEBT & DIVIDENDS-													
13.	EQUITY	($875,793)	($277,473)	($229,623)	($100,281)	$101,931	$217,660	$280,784	$378,032	$330,156	$791,746	$982,653	$381,147	13.
14.	TOTAL INV	($1,045,364)	($308,830)	($160,596)	($36,421)	$176,766	$295,619	$370,024	$482,717	$618,457	$781,899	$971,783	$518,496	14.
	*INTERNAL RATE OF RETURN													
15.	EQUITY												18.12%	15.
16.	TOTAL INV												14.16%	16.

FIG. 7 *The financial statistics and cash flow for cellular radio in rural areas.*

divides it by each year's wireline cellular demand shown on line 10 of Figure 3.

Figure 4 develops the cellular plant construction costs for 17 different plant categories, which are shown in column (B). In columns (C) through (I) the construction costs are shown for each of the seven sample non-MSA, or rural, markets. An average cost of construction by plant category is shown in column (K). All figures reflect third year subscriber demand levels and what TDS believes would be the cumulative plant construction costs through the third year for each rural cellular area. The dollar amounts shown in columns (C) through (I), except for land, digital carrier, vehicles, office equipment and contingencies, are based on actual preliminary price quotes TDS has received from equipment suppliers for these markets. For this discussion TDS has chosen the lowest quotes supplied by domestic manufacturers. The costs for other non-quoted preliminary plant categories are based upon the best estimates available at this time. On line 17, TDS has added an additional 10% of the total of all costs on lines 1 through 16 to cover miscellaneous items and contingencies.

The total estimated three-year construction cost for each market is shown on line 18. The total plant cost ranges widely between markets from $665,000 to $1,372,000. The average cost for these seven rural cellular areas is $968,000, as reflected in column (K). Line 19 again shows the number of proposed cells for each market as planned by our consulting engineers. Line 20 of Figure 4 shows the total cellular plant investment per cell; this calculation is simply line 18 divided by line 19.

Line 21 of Figure 4 calculates the cellular investment per cell excluding the switching equipment; this is another useful measurement.

Figure 5 permits the operating costs of the non-MSA cellular system for the first 2 years of operations to be estimated and summarizes the total capitalized costs of the system. The first item that must be addressed when looking at operating costs is payroll costs. Decisions must be made regarding number of employes, job classifications, pay levels and payroll overheads. The assumptions for a non-MSA market are outlined in columns (C) through (E) on lines 1 through 10. In this market, it is assumed that there will be a need for four employes: first, a technical manager, who also would serve as the general manager, since this is a relatively small market; second, a secretary or clerk; third, a sales manager whose salary would be paid in part on a commission basis; and, fourth an administrative support person. On line 9, 10% has been added to payroll costs to be certain all such costs are covered. This conservative approach—over-estimating expenses and under-estimating revenues—is

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used throughout the model.

The other operating costs are shown on lines 11-19 in Figure 5. Line 11 reflects the recurring costs to the cellular operator of leasing the landlines from the local telephone company to connect the cell sites to the mobile telephone switching office (MTSO) and to connect the MTSO to the telephone company switch. This cost averages approximately $16,400 per cell, but the figure can vary significantly. One way of avoiding this payment to the local telephone company is by installing microwave equipment to handle the cellular traffic between the cell sites and the MTSO. Line 12 is used to reflect the cost of cell site rental, if applicable. It is assumed that land for cell sites is purchased rather than leased. Line 13 shows the costs associated with providing heat, air conditioning and electricity at each cell site. This cost is assumed to be approximately $2000 per cell site. Line 14 is an estimate of the cost of office space rental for the main cellular operating office, including heating, air conditioning and electricity.

Lines 15 through 17 of Figure 5 show estimates of the advertising and sales expense for the construction year and the first two years of operation. In this model, the assumption is based on a specific level of advertising and sales costs per customer. In the first 2 years this cost is $250 per customer and in the second year of operations, it is $200 per customer, as it is through year 10. Line 18 is an additional 20% of the other operating costs to reflect any miscellaneous expenses not included in lines 11 to 17.

Line 19 is the annual depreciation expense. This depreciation expense has been calculated based on an estimated life of 10 years. Where it is financially feasible to do so, TDS would consider depreciating the cellular investment over a shorter, 8 year period. The annual costs as reflected in column (E) then are adjusted, using columns (F) through (H) which show the number of months these costs are anticipated to be incurred in the construction year and in operating years 1 and 2. For example, the technical manager (line 3) would be employed from day 1; thus, column (F), line 3 shows 12 months of expense in year 1. Likewise, TDS would anticipate the telephone circuit costs (line 11) would begin to occur at about the same time as the delivery of the cell site equipment at about the seventh month of operation; and thus, 5 months expense are built into year 1. Columns (I) through (K) thus are calculated by taking column (E) times the appropriate fraction of a year derived from the months shown in columns (F) through (H).

The total annual estimated operating costs are shown on line 22 of Figure 5. Line 23 shows that the construction years pre-operating costs will be capitalized. The operating costs for operating years 1 and 2 as shown on line 24 will be totally expensed. Line 25 calculates the interest that will be capitalized during the pre-operating period; that is, during the construction year. Lines 26 through 28 provide a summary of the costs that would be capitalized and depreciated over the service life of the cellular investment. The three components of the capitalized costs are construction costs, operating costs (deferred construction costs) and interest during construction. Lines 30 and 31 show the year 1, or the first full operational year, cash out-of-pocket operating costs. These costs exclude depreciation expense since it is a non-cash charge. Line 32 of Figure 5 then calculates the total financial requirement for which the cellular applicant must show financing ability, in order to make a filing with the FCC for this Non-MSA market. This total is simply the total capitalized costs plus the first full operational year's out-of-pocket operating costs.

Figure 6 takes the data developed and calculated on prior exhibits and presents it in an operating statement format. This allows TDS to determine the financial feasibility of cellular radio in rural areas. Line 1 shows that an income tax rate of 50% for all 10 years has been assumed. Line 2 reflects the growth in expenses due to inflation. Line 3 shows the cost to the cellular operator per customer per year for what is called customer services. These services include such items as computer billing, data processing and accounting services. Many of these items can be contracted to outside suppliers. Line 4 is taken from exhibit 8, which is not included in this article. Line 5 is computed from Line 3 of Figure 6. Lines 5 to 11 are developed from Figure 5. Line 12 totals operating costs excluding depreciation. Lines 13 through 14 of Figure 6 show depreciation and amortization expense. Line 15 shows net operating income before income taxes. In this example, an operating profit is reached in year 4; excluding depreciation expense, there would be an operating profit in year 3. Line 16 shows the interest cost for each year. The interest cost is computed by taking the average debt outstanding during the year times the assumed interest rate of 13.5%. Line 17 shows taxable income. The first year of taxable income is in year 4, which is the fourth year of operation and the fifth year after the purchase order is issued. Lines 18 through 20 show income tax expense and income tax credits. Line 21 shows net income after tax; it is positive in year 4.

Line 1 of Figure 7 shows return on average equity capital for the year. Return percentages in early years can be misleading because equity declines rapidly, goes negative to 3 years and then builds back up rapidly. Line 2 shows return on total capital invested. This return figure is computed in a utility fashion since it does not add back income taxes. Line 3 gives the times interest earned ratio. Lines 4 through 8 compute the net cash available from operations after interest expense and taxes.

Lines 9 and 10 of Figure 7 deduct estimated repayments of principal on the debt and estimated dividends on the equity to arrive at net operating cash flow. These assumptions can easily be changed to repay debt principal more quickly, to avoid cash build up in the cellular operation and so on. Cash depletion and build up are reflected in line 12 (culmulative cash from operations). Line 13 shows the net equity input required and the net equity paid out to shareholders for each year. In the first 2 years the model assumes that cash shortfalls from operations (line 8) and 40% of new plant additions are financed through added equity inputs. Line 14 shows the net investment (debt and equity required for the project) for each year. Line 15 shows the internal rate of return on equity dollars invested in the project. This is a compound cumulative return on equity figure for the first 10 years of the project assuming the system is worth only book value at the end of the tenth year and it could be worth many times this figure. This rate of return can be compared to the return available from alternative non-cellular investment projects. Line 16 shows the internal rate of return on total dollars (debt and equity) invested in the project.

Based on the model results TDS has concluded that cellular appears feasible in the average non-MSA market. Feasibility in any particular market will depend on the specific demand—cost characteristics of that market. □

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